Introduction to Botany. Lecture 39

Alexey Shipunov

Minot State University

December 7, 2011

Outline

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Previous final question: the answer

How to distinguish Rosaceae and Leguminosae?

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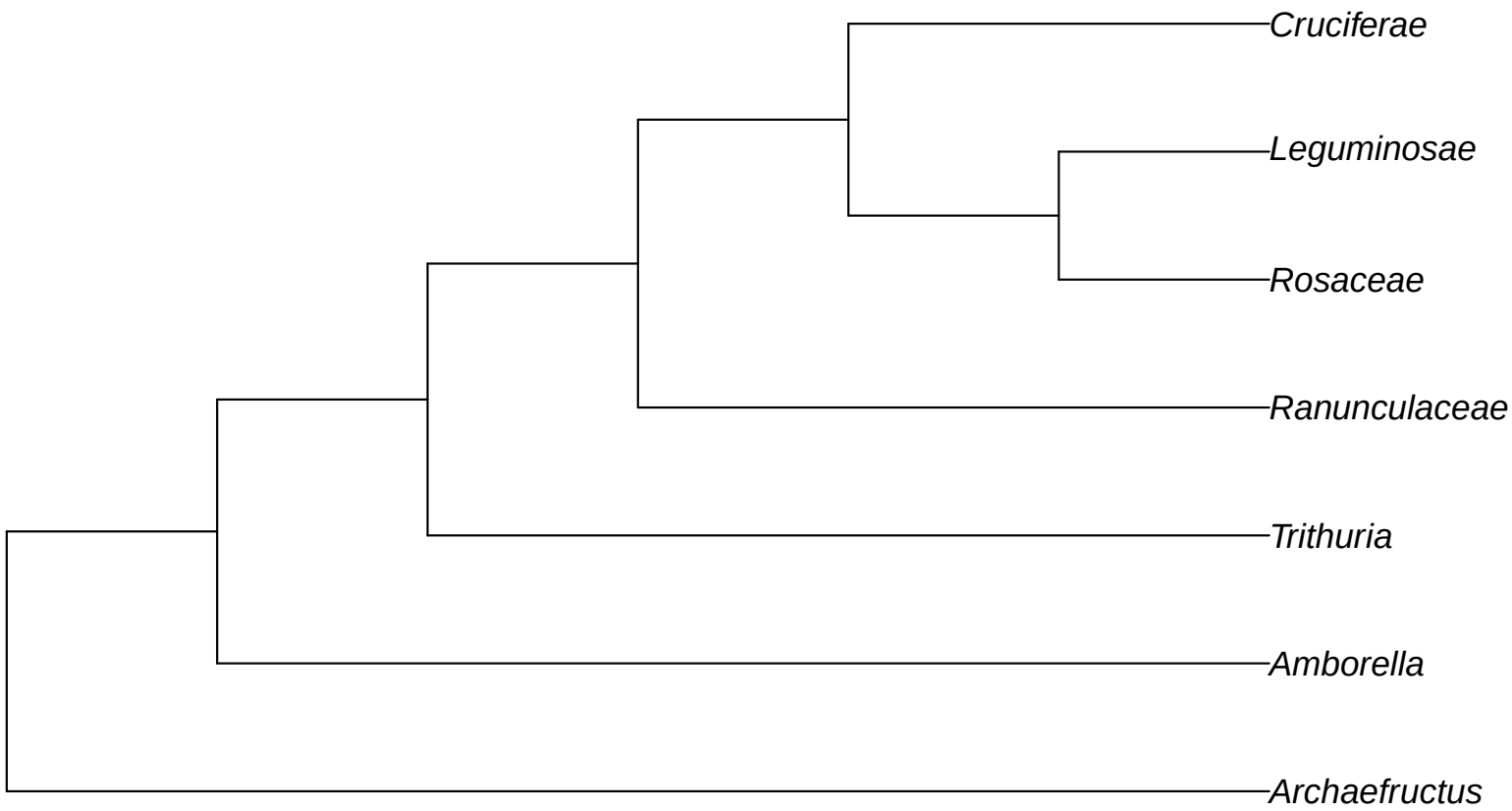
How to distinguish Rosaceae and Leguminosae?

- One pistil with one carpel + root nodules + compound leaves with stipules in legumes
- For Papilionoideae, differences are more expressed: banner, keel and wings in flowers
- But the most important is a **legume fruit**

Phylogeny of angiosperms so far



Plan of family characteristic

- Meta-information: name, position in classification, number of species, distribution
- Ecological preferences
- Morphology and anatomy of stem, leaf and root
- Generative organs from inflorescence to fruit, including flower diagrams and formulae
- Seed
- Representatives and their importance

Rosidae, or rosids

Cruciferae, or Brassicaceae—cabbage family

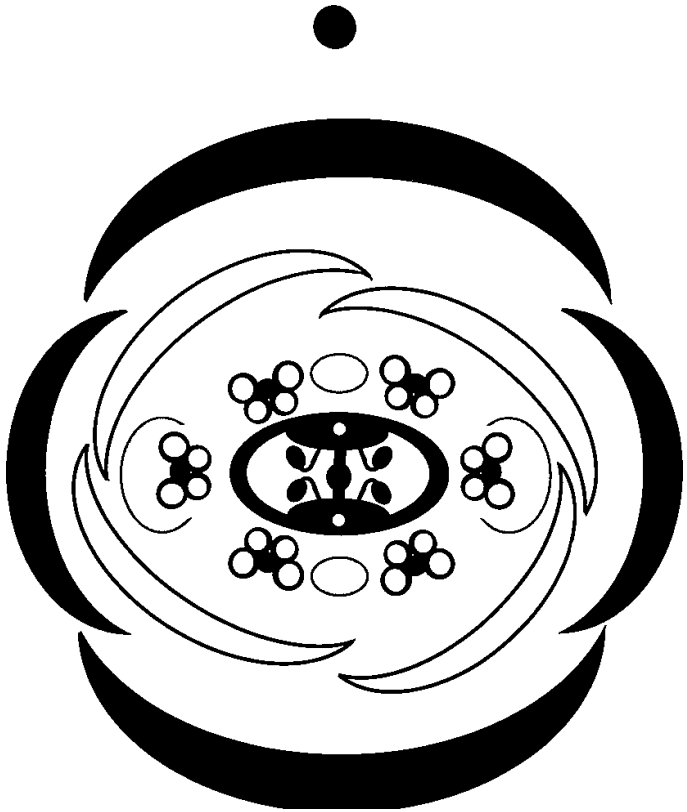
General features of Cruciferae

- $\approx 3,000$ species
- Found mostly in temperate regions, especially in dry climates
- The core part is extremely uniform, both morphologically and ecologically

Morphology of core Cruciferae

- Herbs, often hairy, contain mustard oils (similar to other families of alliance like Caricaceae, papaya family)
- Leaves simple, often dissected, alternate, without stipules
- Flowers dimerous, in racemes
- 4 sepals, 4 petals, ancestrally also 4 stamens but inner stamens split each in two = 6 stamens in total
- Pistil has two carpels
- Fruit is a siliqua: dehiscent, with two cameras and replum bearing seeds
- Mature seeds with small amount of endosperm

Cruciferae flower



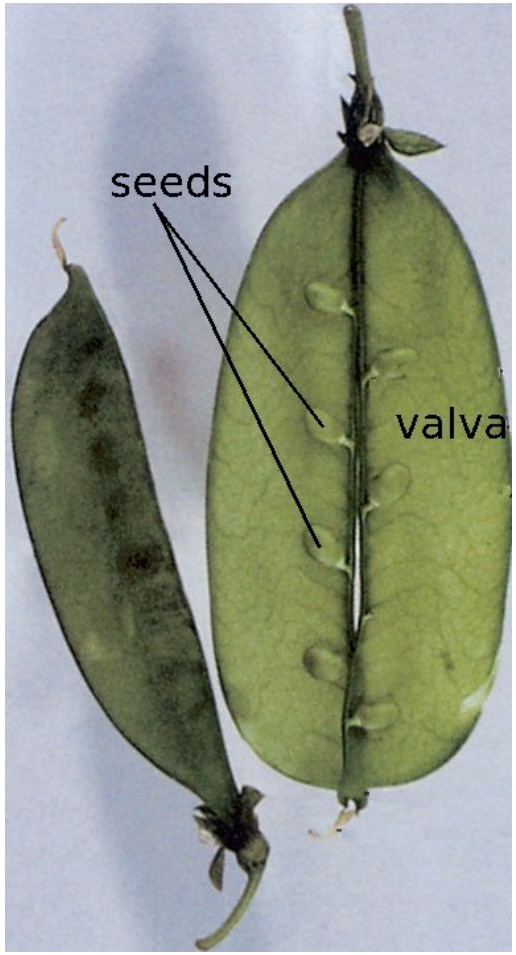
$$\ast \mathrm{K}_4\mathrm{C}_4\mathrm{A}_{2+2,2}\underline{\mathrm{G}_{(2)}}$$

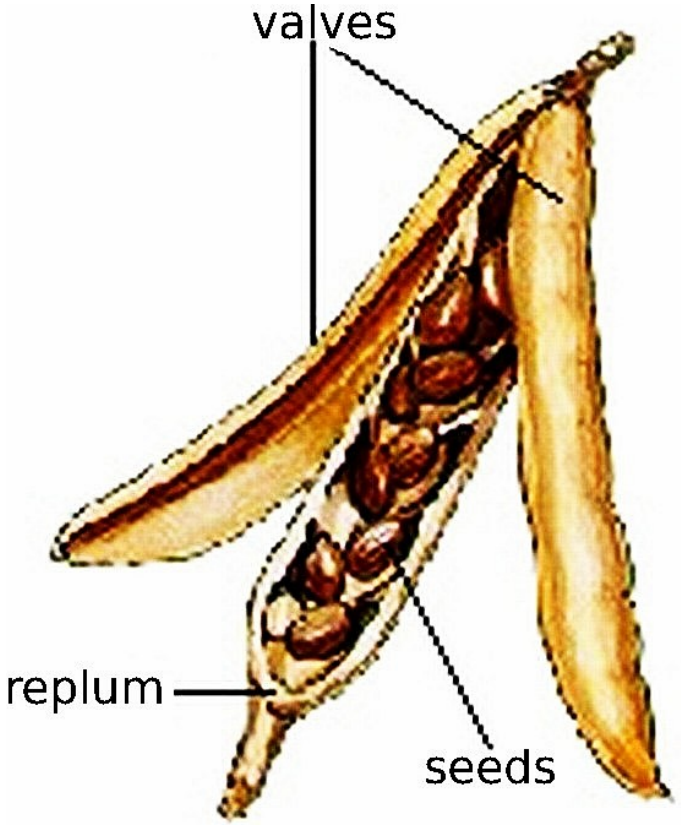
Representatives of Cruciferae

Important vegetables and spices, e.g.

- *Brassica oleracea*—broccoli, cabbage, cauliflowers
- *Brassica nigra*—black mustard
- *Brassica rapa*—turnip
- *Raphanus*—radish
- *Armoracia*—horseradish
  and
- *Arabidopsis thaliana*—famous model plant

Legume and siliqua





Arabidopsis thaliana

Asteridae, or asterids

General features of asterids

General features of asterids

- Dimerous or pentamerous flowers
- Often haplostemony (one cycle of stamens)
- Petals fused
- Corolla monosymmetrical (zygomprphic)
- Most asterids are herbs

Asteridae, or asterids

Solanaceae—potato family

General features of Solanaceae

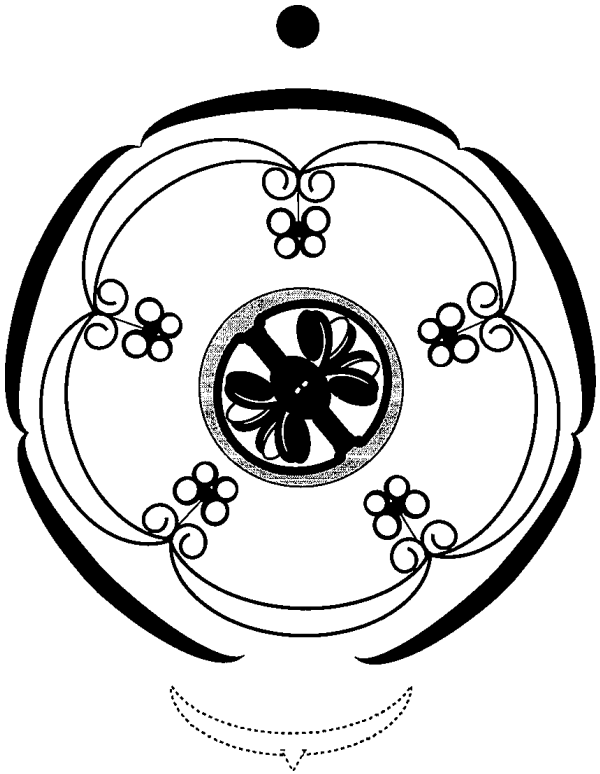
Solanaceae—potato family

- $\approx 2,300$ species, most of them belong to one genus, *Solanum*
- Cosmopolitan, with center of diversity in South America
- Prefer places with good water supply

Morphology of Solanaceae

- Herbs, shrubs, vines, small trees; produce alkaloids, often poisonous
- Stems with bicollaterate vascular bundles
- Leaves alternate, without stipules, with pterodromous venation, simple or compound
- Flowers in cymes, actinomorphic (polysymmetric)
- Petals fused, stamens are attached to corolla
- Pistil has two carpels oriented obliquely to median plane of flower
- Fruit is mostly berry or capsule; seeds with well-developed endosperm

Solanaceae flower



$$\ast \mathrm{K}_5[\mathrm{C}_{(5)}\mathrm{A}_5]\underline{\mathrm{G}_{(2)}}$$

Explanations for simplified formulas

- Flower in general: $*$—actinomorphic, or polysymmetric, or radial; $\uparrow$—zygomorphic, or monosymmetric, or bilateral
- Sterile zone: P—members of perianth (tepals) OR K—calyx (consissts os sepals) AND C—corolla (petals)
- Male zone: A—androecium (consists of stamens)
- Female zone: G—gynoecium (consists of pistils, pistils consist of carpels)
- Brackets () or [] or || mean fusion
- Dash $-$ means variation, “3–5” means 3, 4 or 5
- Plus $+$ means circles, C_{5+5} means 5 petals in outer circle and 5 petals in inner circle
- Comma “,” means differences within one circle, e.g. in Leguminosae petals $\mathrm{C}_{1,2,2}$ 1 is banner, 2 are keel and last 2 are wings
- Multiplication sign $\times$ means dilatation
- Infinite sign ∞ means number > 12 and non-stable, e.g. apple flower could have 21, 23, 27 or even more stamens, and we use A_{∞} for that
- Overline/underline mean inferior/superior ovary, or epiginous/hypoginous flower: e.g., $\mathrm{G}_{\overline{(2)}}/\mathrm{G}_{\underline{(2)}}$

Representatives of Solanaceae

Mostly vegetables and spices

- *Solanum*—include potato (Solanum tuberosum), tomato (Solanum lycopersicum) and eggplant (Solanum melongena)
- *Capsicum*—red (Mexican) pepper
- *Nicotiana*—tobacco
- *Petunia*—important ornamental
- *Atropa*—belladonna, important medicine plant, source of atropin

Solanum tuberosum (potato) fruits

Solanum melongena (eggplant) flowers

Asteridae, or asterids

Compositae, or Asteraceae—aster family

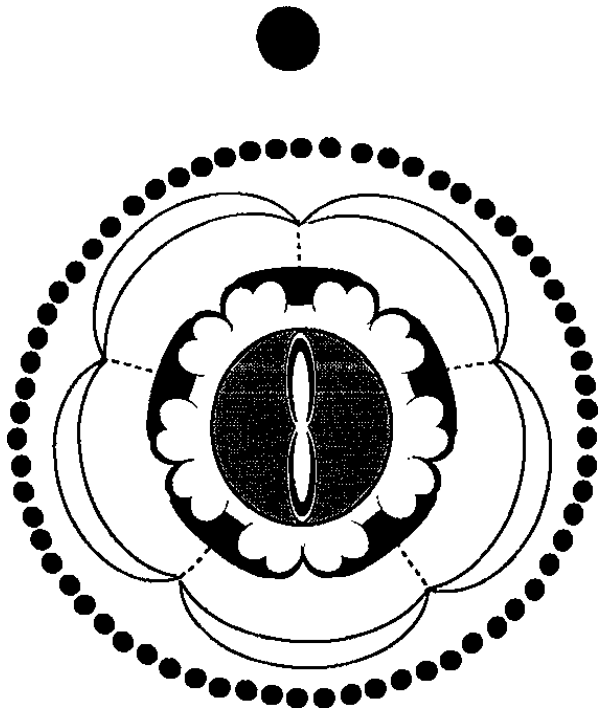
General features of Compositae

- More than 20,000 species
- Cosmopolitan, but better represented in temperate and subtropical regions
- Prefer open spaces

Morphology of Compositae

- Herbs, rarely woody plants; store carbohydrates as inulin (not starch), sometimes have resin or laticifers (subfamily Cichorioideae)
- Leaves alternate or opposite, without stipules, with pterodromous venation
- Flowers in involucrate heads which mimic one flower
- Calyx reduced to hairs or bristles (pappus), petals fused in tube or ligula (with 5 or 3 teeth)
- Stamens 5, fused by anthers
- Pistil has 2 carpels, ovary inferior
- Fruit is achene, mature seed has almost no endosperm

Compositae flower



$\ast \mathrm{K}_{\infty}\mathrm{C}_{(5)}\mathrm{A}_{(5)}\mathrm{G}_{\overline{(2)}}$ (tubular flower) or $\uparrow \mathrm{K}_{\infty}\mathrm{C}_{(3\vee 5)}\mathrm{A}_{(5)}\mathrm{G}_{\overline{(2)}}$ (ligulate flower)

Tubular and ligulate flowers in *Matricaria* sp. (chamomile)

Representatives of Compositae

Oil plants, vegetables, ornamentals and medicinal plants distributed in 12 (!) subfamilies, most important are three subfamilies:

- Carduoideae: mostly tubular flowers
  - *Centaurea*—knapweed
  - *Cynara*—artichoke
  - *Carthamus*–safflower
- Cichorioideae: mostly 5-toothed ligulate flowers + lacticifers with latex
  - *Taraxacum*—dandelion
  - *Lactuca*—lettuce
- Asteroideae: tubular + 3-toothed ligulate flowers
  - *Helianthus*—sunflower (BTW, “canola”, or Brassica napus from Cruciferae is the second main source of vegetable oil)
  - *Artemisia*—sagebrush
  - *Tagetes*—marigold and lots of other ornamentals

Cynara cardunculus (artichoke)

Carthamus tinctorius (safflower)

Tagetes patula (marigold)

Summary

- Cruciferae is a representative of “mustard-oil containing families”, the other alliance
- Compositae is probably the most advanced family of angiosperms

Final question (2 points)

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Why Compositae is often considered as most advanced family among angiosperms?

For Further Reading

J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapter 23.

Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 25.